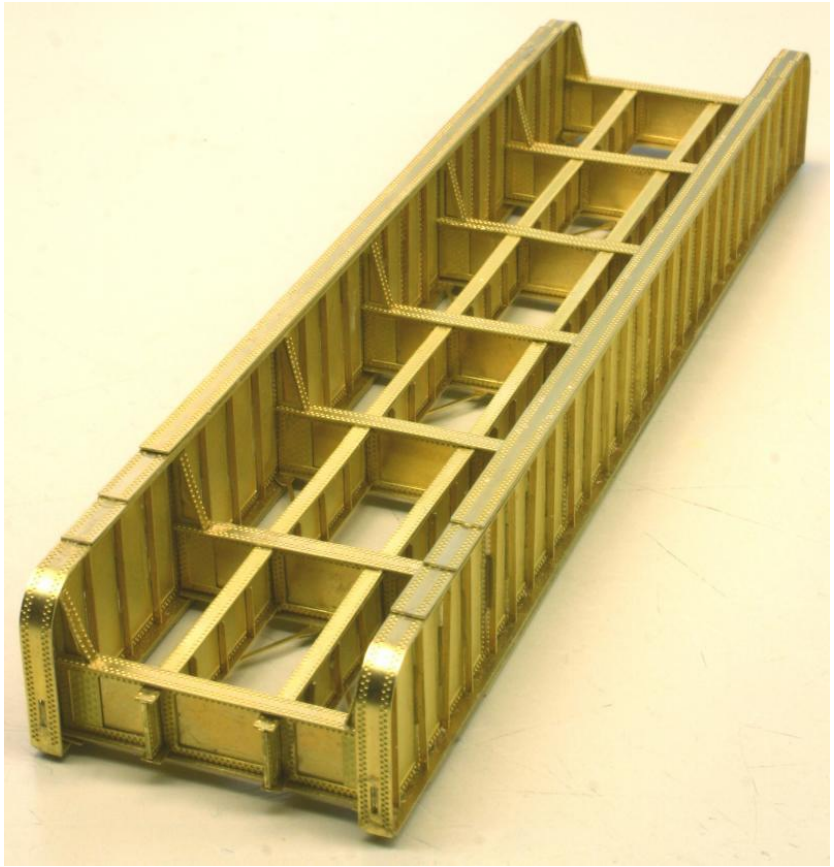
Replacing Through Girder Bridges

Jones Road over Route 4

Why did they build Thru-Girder Bridges anyway?

- Through Girder (Thru-Girder) bridge actually have a lot of advantages:
  - ***Easy to build-*** very few 'moving parts'
  - ***Easy to design*** – simple load paths
  - ***Easy to fit*** – shallowest effective superstructure depth of any bridge

Many still in service for over 100 years with negligible maintenance



Why did they stop building Thru-Girder Bridges?

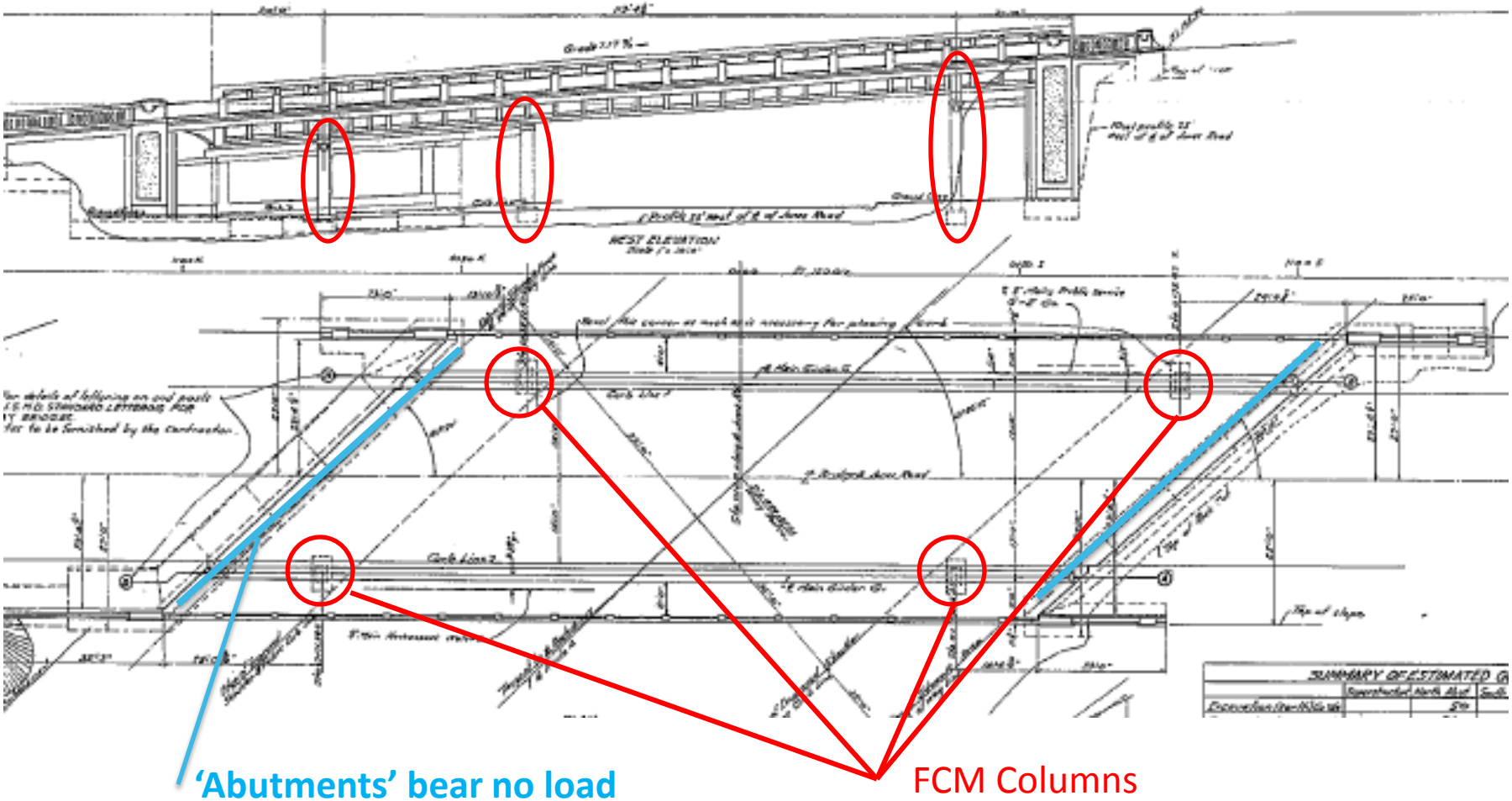
- Through Girder (Thru-Girder) bridge actually have a lot of advantages:
  - ***Rolled section girders –*** *become readily available and cheap*
  - ***Roads get wider-*** no limitations on width or shape of deck
  - ***Super simple design***– straight steel rolled section non-composite overpasses - ‘any idiot with a slide rule’…
  - **Considered structurally redundant**

Still the industry standard today

Jones Road Bridge

- Built in 1931
- Through-Girder Bridge
- Inspection report is SD/FO
- Multiple bridge strikes (13’-4” MVC)
- HNTB scope was to develop replacement concepts

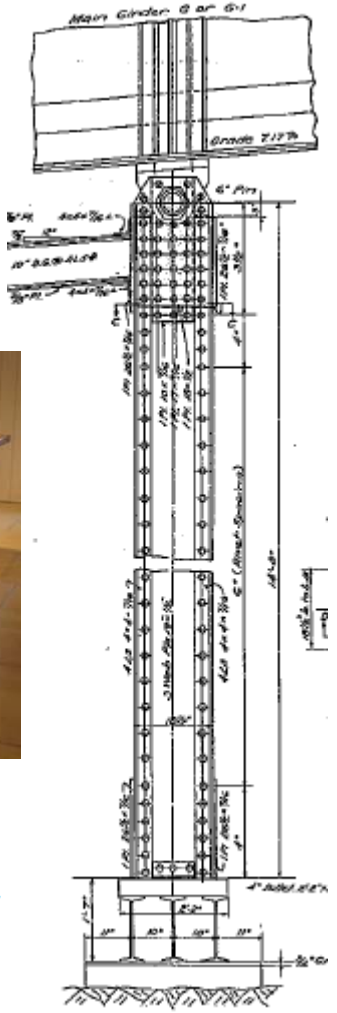
FCM columns hiding in Plain Sight



FCM columns hiding in Plain Sight

- Abutments don't actually do anything
- All support by 4 'pier' columns- *like your kitchen table*
- Laced built up steel in concrete
- No credible protection from impact.

Lose one leg – lose the whole bridge – and Route 4

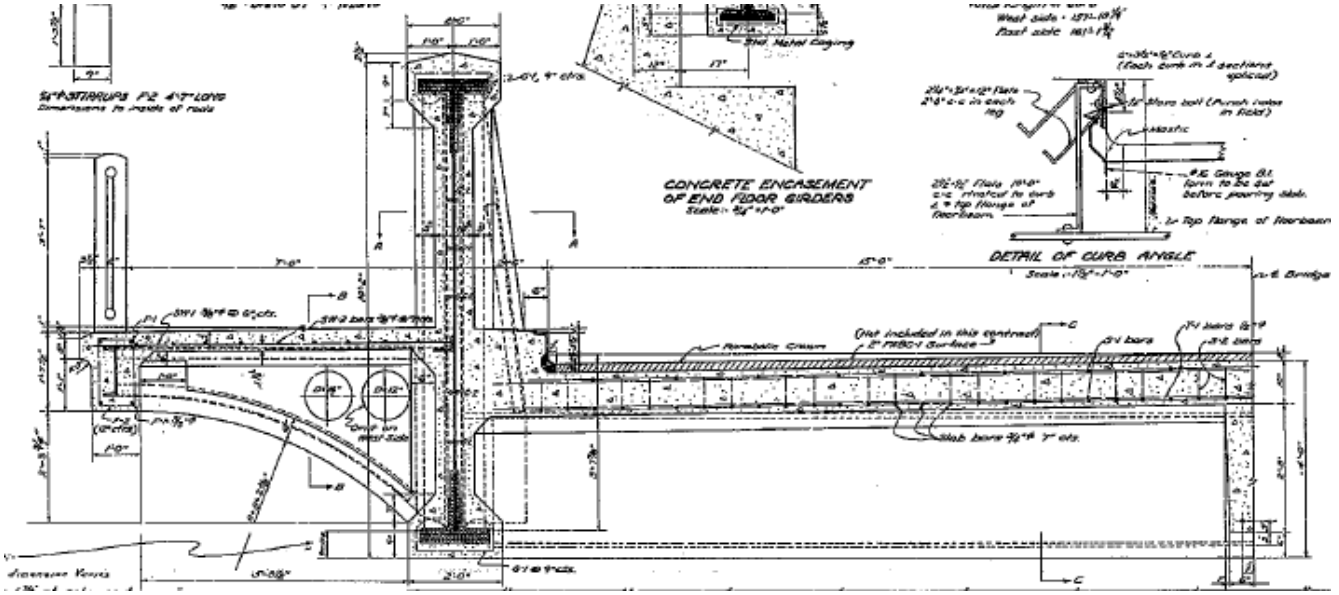


Ok, so how to replace this thing?

Options Considered

Staged Replacement:

- 2-girder system can't be "partially' demolished – need risky/expensive strongbacks
- Abutments not designed to bear vertical load.
- *Not a chance!*



Options Considered

Explosive Demolition with Closure

- Same problem: Can't partially demolish- it's all or nothing.
- Remove any one member and it all comes down.
- Would have to blow-it up and scrape the bits off of Route 4- could take days.
- Adjacent residences
- *Not a chance!*

Options Considered

Self Propelled Modular Transport (SPMT)

- Pick up the entire old bridge in one shot
- Get it off the road and onto the grass
- Demolish the hulk with discretion (or without, depending on mood)
- Bonus points- the SPMT can be used to put up the new bridge, too.
- *The only way to go!*

What should the new bridge be?

New Bridge Options

Multi-Girder 2-span with Pier in Median

- Would require a new pier to be built at the median
- Would require raising Jones Rd. by 2’ to make the 2, 100’ spans.
- requires long term closure of left lanes of Route 4
- Pushes traffic closer to FCM pier columns
- Pier would be at apex of blind curve on Route 4
- *Long-term road closure*
- *Deemed undesirable*

Multi-Girder Single Span

- Would require raising Jones Rd. by 5 ft. to make the 200’ span.
- Complete reconstruction of interchange ramps
- Various green acre impacts and property takings.
- *Long-term road closure*
- *Deemed undesirable*

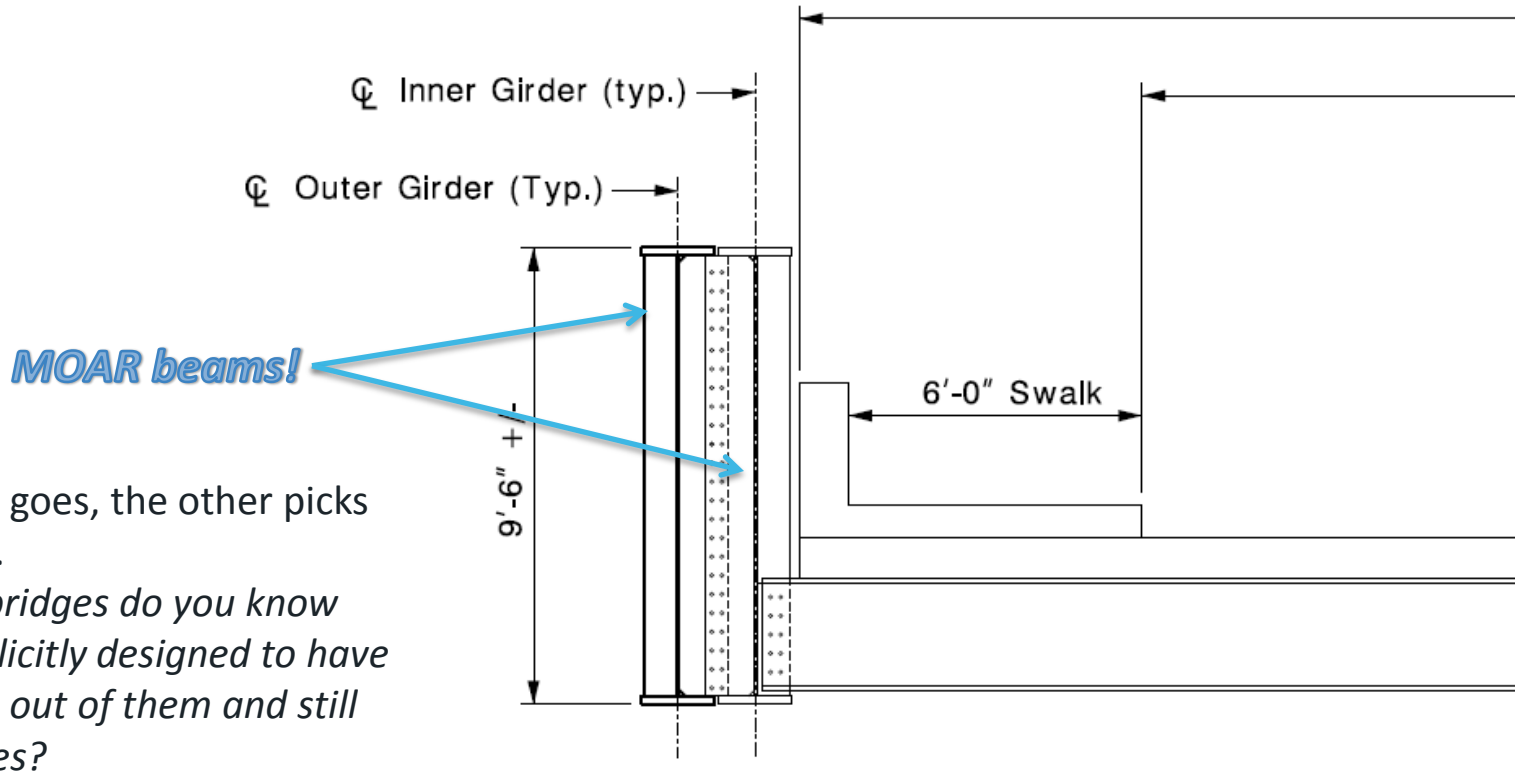
Replacement Thru-Girder

- No road impacts
- No property Impacts
- Any length we want
- *Not Redundant – but can we fix that?*

Making the Thru-Girder Work

Why isn't a Thru Girder Redundant?

- Only 2 beams: Take-out one beam, the whole bridge falls
- *Simple Solution: Just add more beams!*



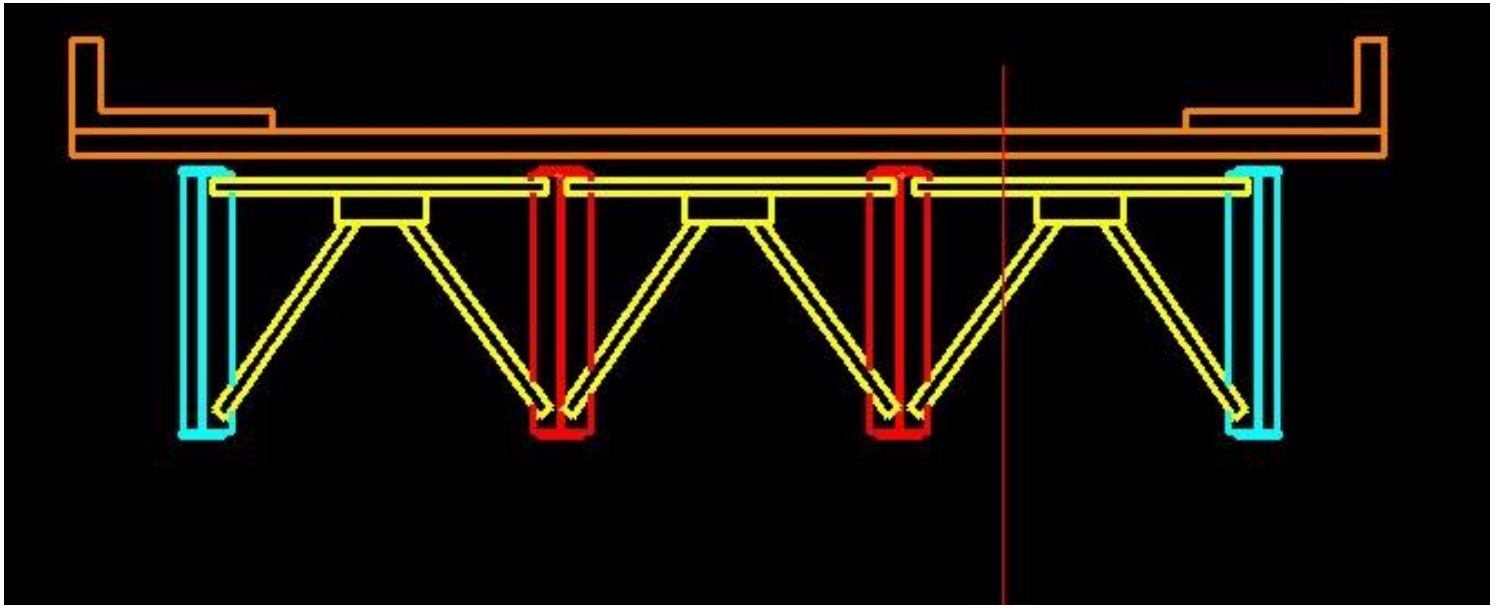
- If one girder goes, the other picks up the slack.
- *How many bridges do you know that are explicitly designed to have a beam torn out of them and still carry all lanes?*

HNTB

Making the Thru-Girder Work

But does doubling the beams really make it redundant?

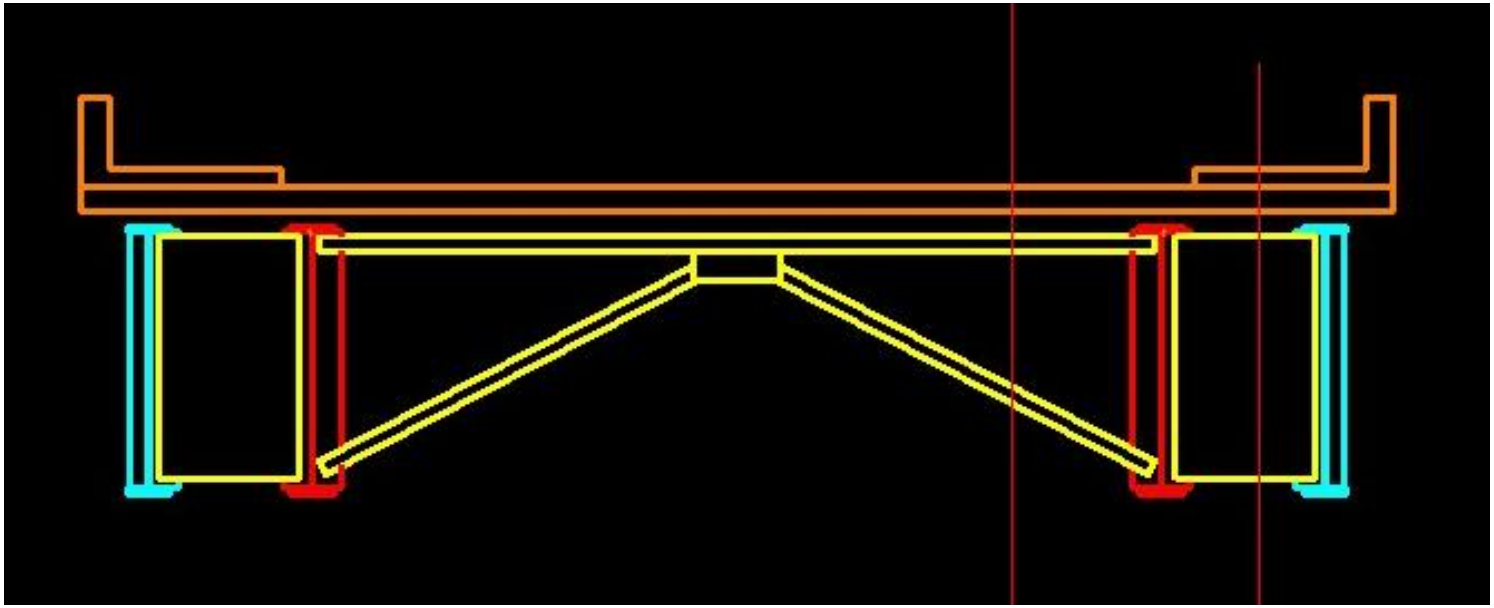
- Maybe – let's look at what is redundant:
- Typical section below: 4 girders at Eq. Spa. under a deck. – typical bridge
- Lose one girder, three remain, but you might lose the sidewalk and shoulder if fascia hit
- It's redundant, right?



Making the Thru-Girder Work

But does doubling the beams really make it redundant?

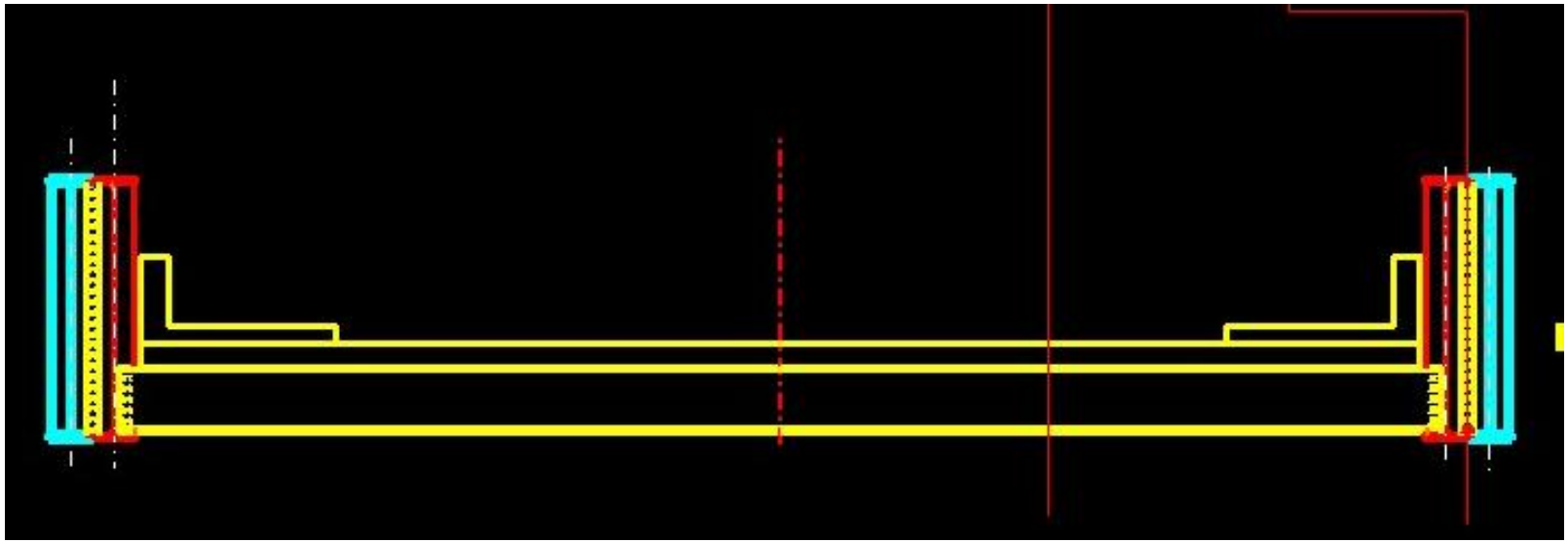
- Slightly different, but still meets ‘ 4 girders’ critiera
- Typical section below: 4 girders at unequal. spa. under a deck.
- Lose one girder, three remain, but you might lose the sidewalk if fascia hit
- Still redundant?



Making the Thru-Girder Work

But does doubling the beams really make it redundant?

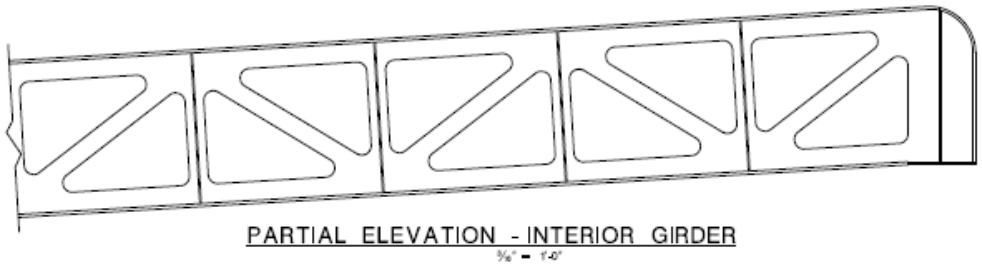
- Concept Bridge – stick the deck between the paired girder
- Typical section below: 4 girders paired connected by heavy diaphragms and floorbeams
- Lose one girder, three remain, but you lose nothing – floorbeams still fully supported
- Even if interior beam is hit, every floorbeam and diaphragm is a redudnant load path to the surviving girder.
- How is this not redundant?



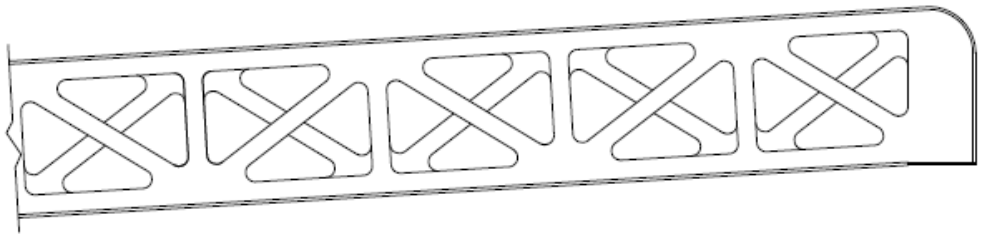
Making the Thru-Girder Work

Why the cut-outs?

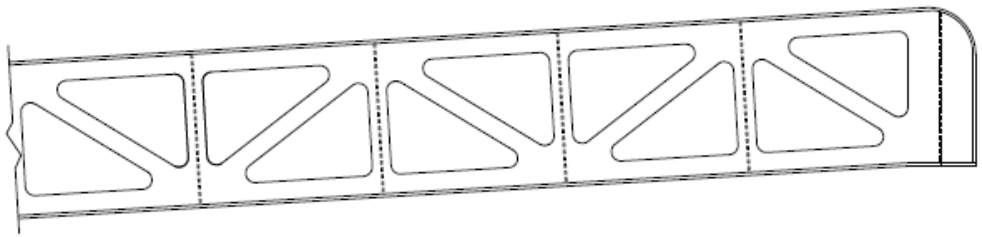
- Makes connection between girders easy.
- Eliminates confined space issues of box beams
- Allows ventilation in tight quarters
- Looks really cool.



PARTIAL ELEVATION - INTERIOR GIRDER



PARTIAL ELEVATION -GIRDER ASSEMBLY



PARTIAL ELEVATION - EXTERIOR GIRDER

Making the Thru-Girder Work

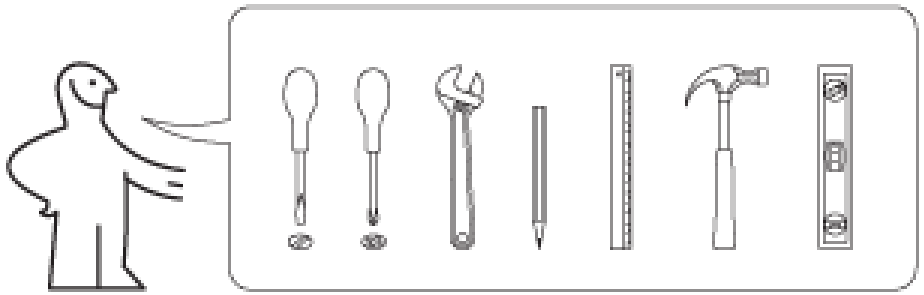
That can't work!

- Wanna bet?

Making the Thru-Girder Work

OK, you sold me, but how does the bridge go together? IT MUST be harder than a normal bridge

- Explicitly designed bridge to be easy to put together
- We assume you've been to Ikea...



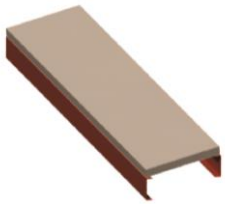
Middle Girder Unit

X 4

End Girder Unit

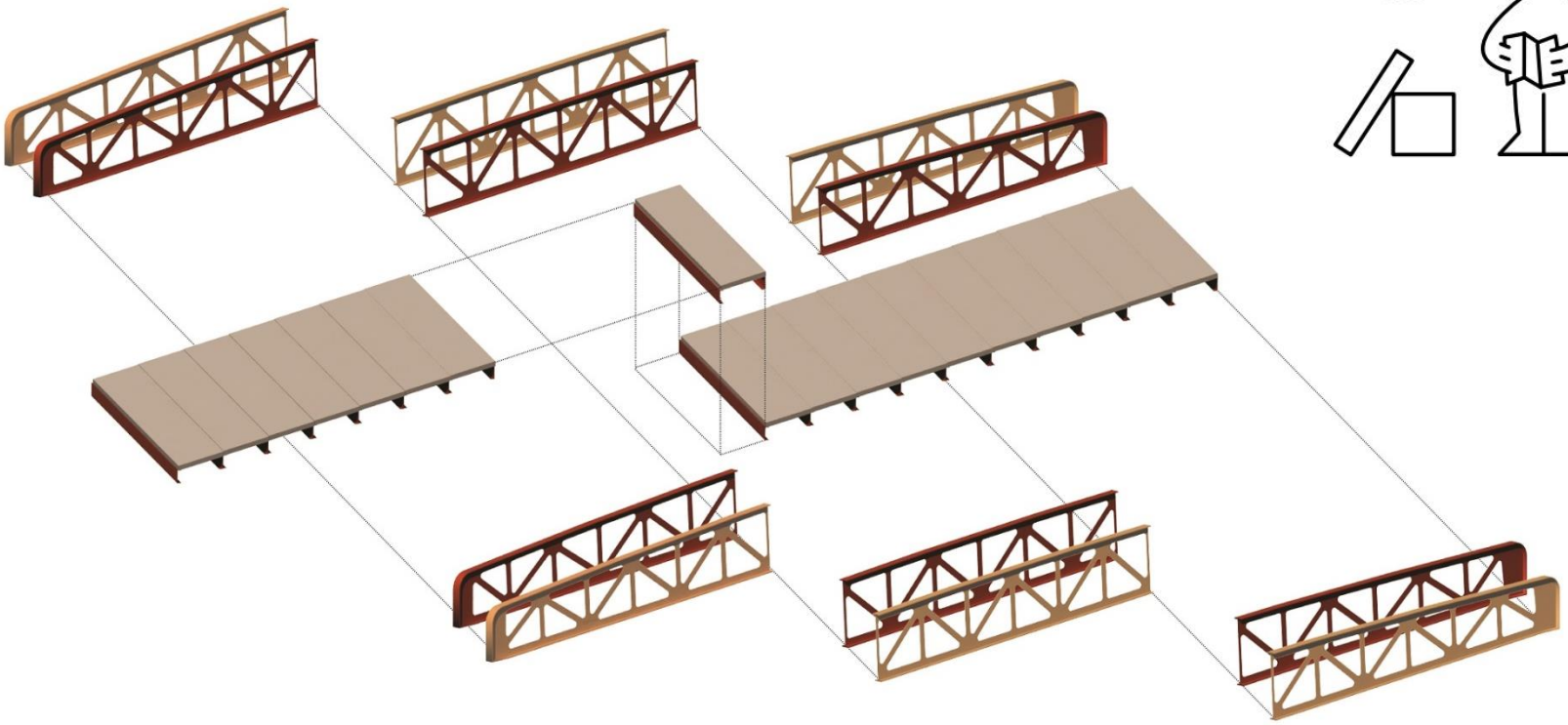
X 8

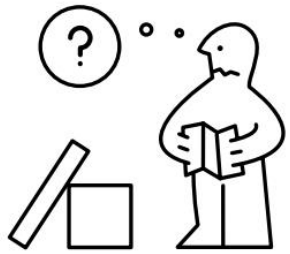
Deck and Floorbeam Unit



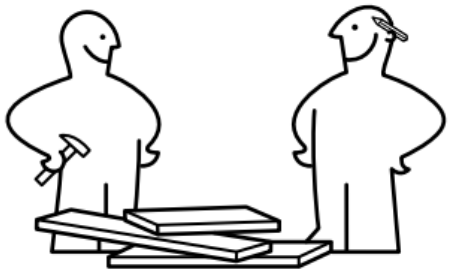
X 20

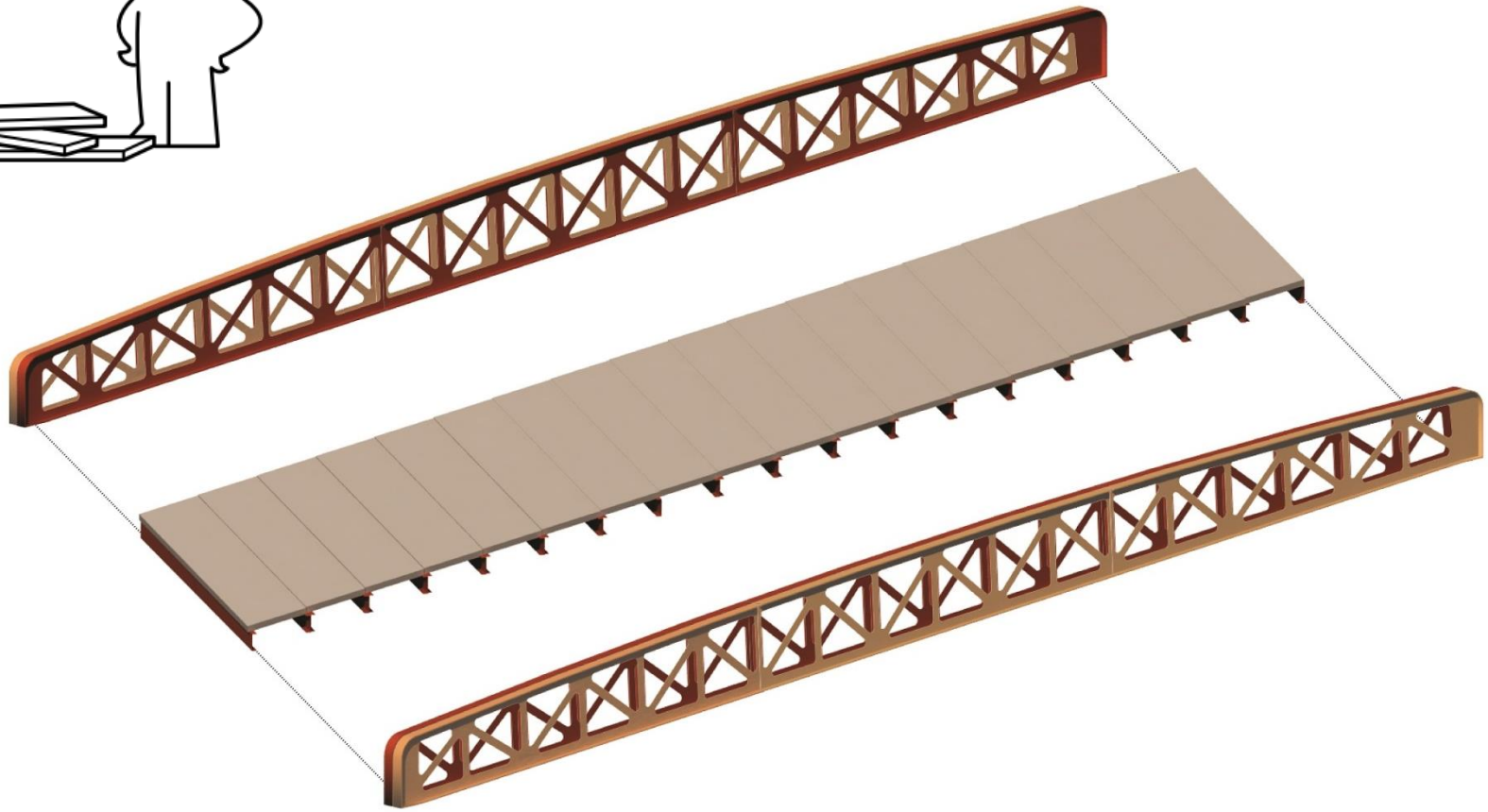
Making the Thru-Girder Work



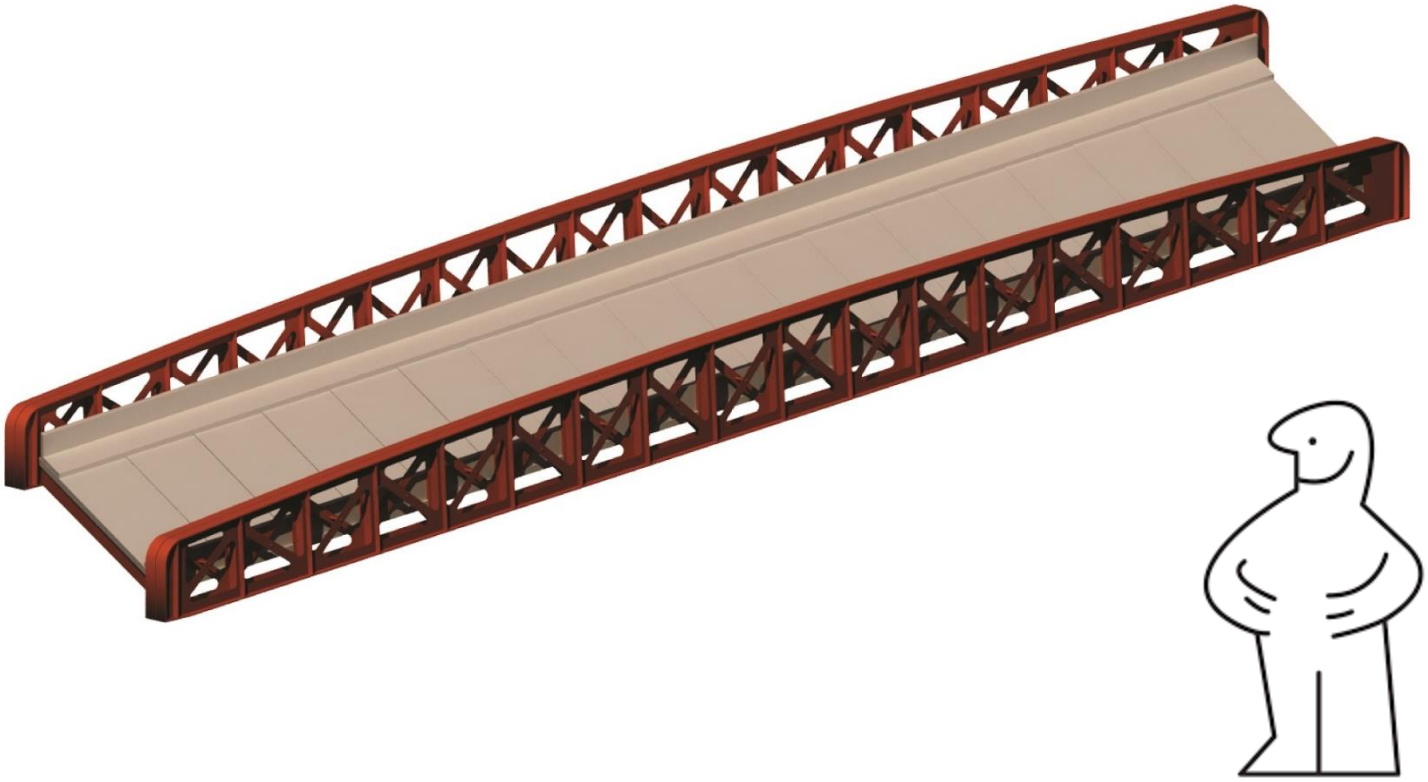


Making the Thru-Girder Work





Making the Thru-Girder Work



OK, but how were you gonna install it?

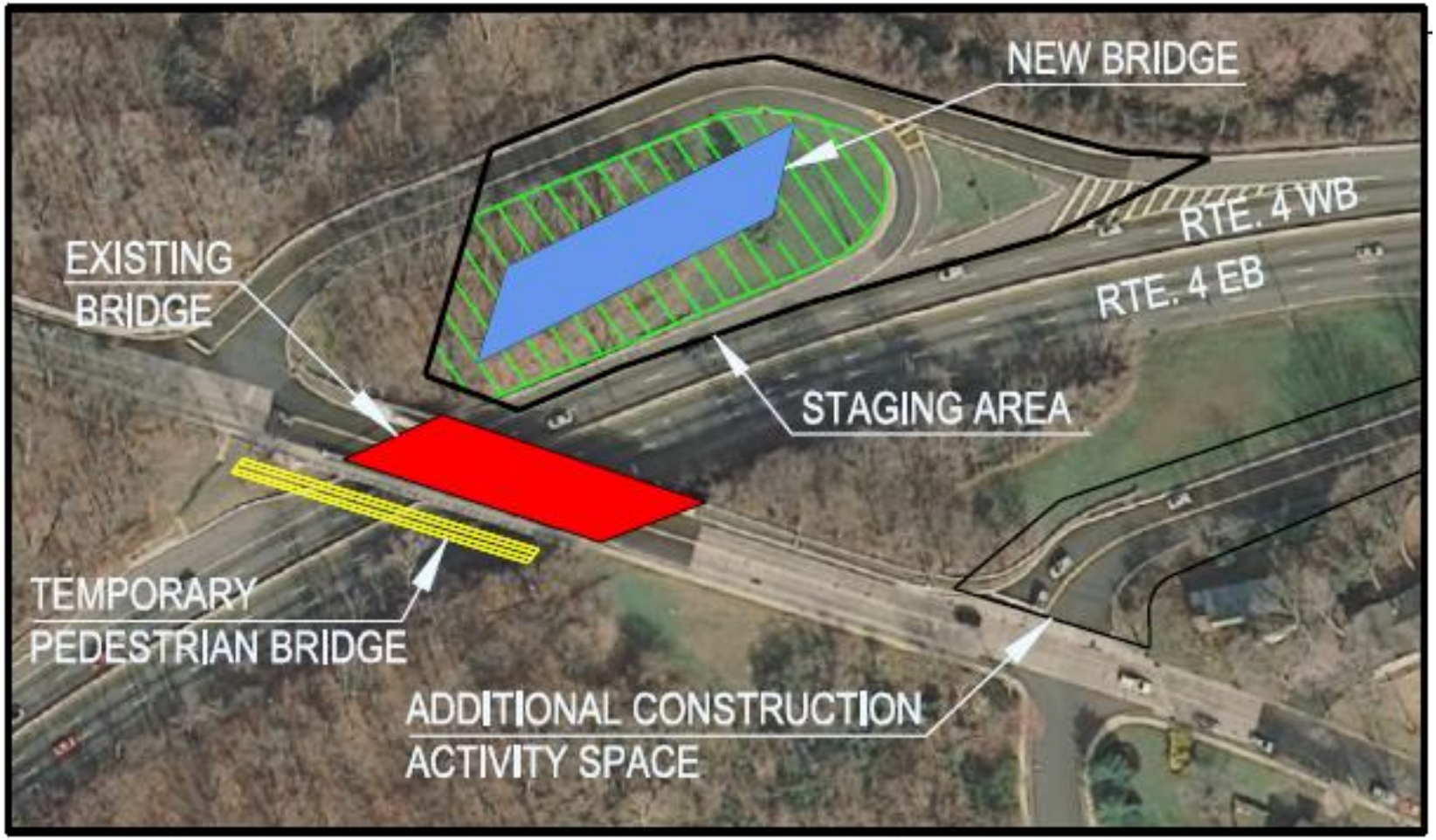
OK, but how were you gonna install it?

Use the ramp infield

- Just enough room to build a bride
- Or enough to take the old one
- BUT NOT BOTH!

- Gonna have to be a shell game to make it work with the space available

The ‘Shell Game’



The ‘Shell Game’

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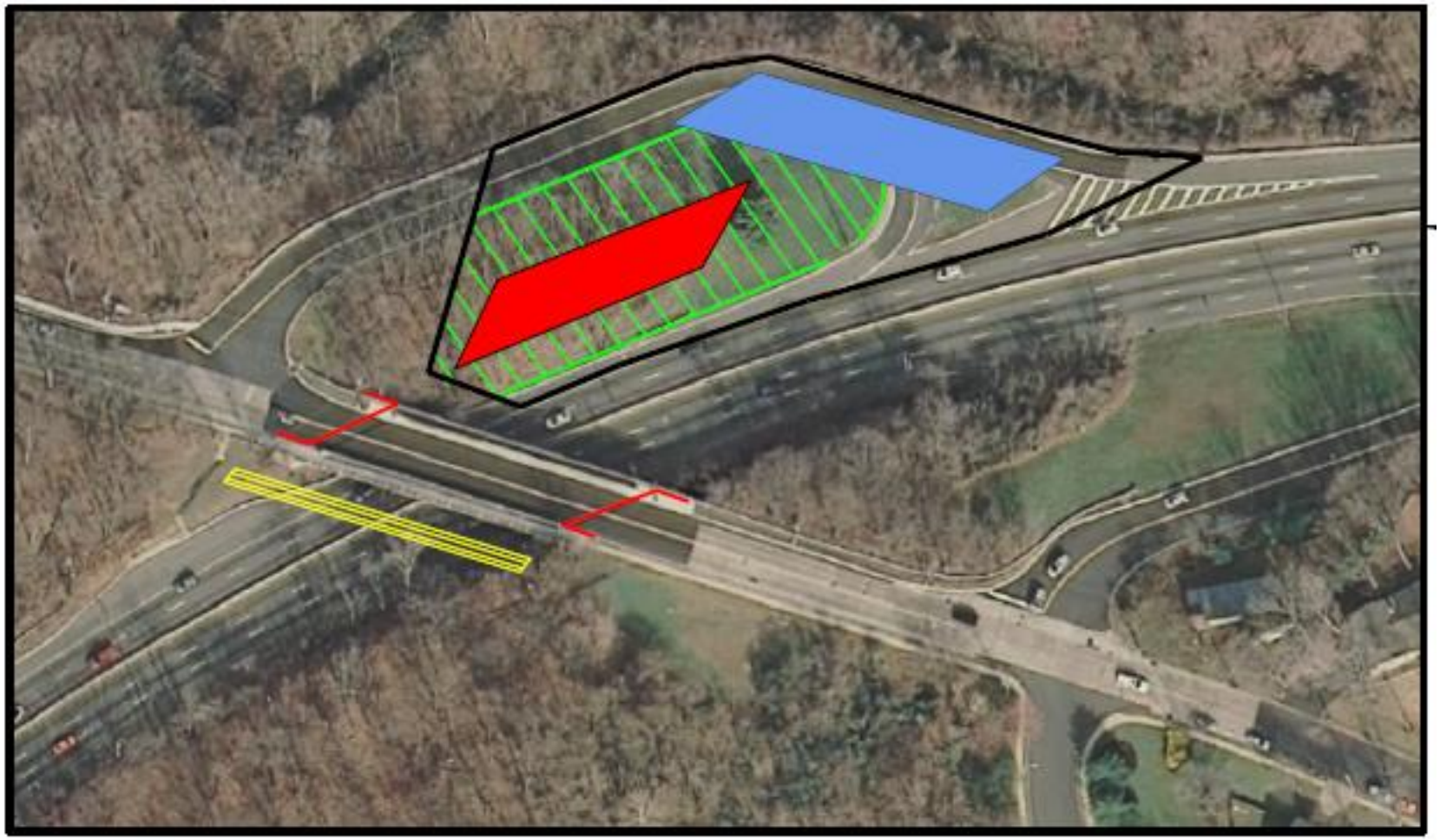

Questions?